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Role of veterinarians in modern food hygiene

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Veterinary services and veterinary education and training must keep pace with the constantly changing patterns of agriculture and food processing. Changes in methods of animal production are associated with many problems of food processing and food quality. Veterinary supervision of the animal feed industry and of meat and distribution is essential. Quality testing of meat, milk, and eggs requires the introduction of suitable routine sampling systems, laboratory procedures, and complex evaluation procedures.

Food hygiene problems have changed in recent years not only as a result of new methods of animal production, but also because of changes in food processing technology and in the presentation of food to the consumer, increased environmental pollution, increased international trade, and increased tourist travel.

Food hygienists must adopt an active and progressive policy and change the scope of food control from a purely negative measure into a positive force working towards improved food quality and the avoidance of losses during production. A modern food hygiene programme should cover all stages of production, processing, and distribution of food and also other ingredients, additives and the water used for production and processing. Veterinarians should also be involved in the registration and licensing of enterprises and this should take into account the premises, the procedures to be used, new techniques in animal husbandry, machines and equipment, etc.

In order to facilitate the microbiological analysis of foodstuffs, new mechanized or automated laboratory methods are required, and consideration must be given to adequate sampling techniques.

An essential part of any national socioeconomic programme is the systematic development of a well-functioning agriculture/food industry complex. Veterinarians have assumed great responsibilities in these fields and experience has shown that their contributions have been most valuable. However, it is imperative that veterinary education and training, as well as veterinary services, keep pace with the constantly changing patterns of agriculture and food processing.

THE CHANGING PATTERN OF ANIMAL PRODUCTION

Only adequately organized and managed veterinary services will be able to cope with many of the new problems in animal production brought about by socioeconomic, technological, and ecological changes.

These changes are related to increases in human population, urbanization, and new agricultural techniques and practices—large concentrations of animals in comparatively small areas, maximum use of agricultural and food chemicals, development of virgin territories in developing countries, etc. The emerging problems include increased health

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risks, decrease in the quality of the food produced, and environmental pollution from animal sources.

Veterinary services should not only be well prepared to cope with these problems, but should play a more active part in the development of animal production. Their efforts should aim at prevention of losses associated with animal production and should contribute to the maximum production of top quality food. The introduction of new agricultural and food processing techniques and practices, and the remodelling of existing ones, should be thoroughly studied by veterinary services; they should be involved in planning and licensing of new enterprises and should closely supervise them, particularly at the start of operations.

There is no doubt that adequate knowledge of food hygiene and technology is indispensable for field veterinarians, and its importance will increase with the development of larger farms. They should also be aware of the various agricultural factors that influence the quality of food, particularly feed and feeding techniques. In order to prevent health risks and to maintain food quality, the feed industry should be under veterinary supervision. The criteria governing the elaboration of regulations for this type of supervision should be similar to those for food of animal origin.

Close cooperation should be established and maintained between field veterinarians, particularly veterinary meat inspectors, and food hygienists in order to establish a continuous exchange of information. For example, in today's conditions it is difficult for the meat inspection services to judge slaughter animals and their meat adequately without appropriate information from field veterinarians about such factors as the epidemiological situation, vaccination, treatment, drugs, or chemicals used. Naturally, the primary aim of this kind of cooperation lies in the prevention of health risks, but in healthy animals the aim would be to increase food quantity and quality and prevent any avoidable losses in animal production.

There is evidence that the introduction of new techniques and practices into the agricultural and food industries has resulted in certain discernible changes in food quality values. Moreover, an increasing number of animal health disorders have been observed for which the new or remodelled, and inadequately tested techniques seem to be responsible.

Veterinary activities should therefore include regular testing of a certain number of animals, and their meat, milk, and eggs, for quality in the broadest sense of the word. Such testing should include:

— gross composition of food

— specific composition (nutrients such as amino acids, fatty acids, vitamins, minerals, antinutritional agents, etc.)

— nutritional value

— keeping quality

— hygienic quality

— safety

— suitability for further processing into food products (e.g., not all meat is suitable for ham production)

— suitability for further culinary preparation

— acceptable organoleptic properties in relation to local food habits.

Before such a system of quality testing can be adopted, it is necessary to develop and introduce suitable routine sampling systems, laboratory procedures, and complex evaluation methods. In addition it is essential to ensure sufficient manpower and laboratory facilities to implement the recommendations.

Some of these tests can be made at slaughter. Ante- and postmortem meat inspection practice should consist of:

(1) routine inspection;

(2) extended inspection dictated by the findings of (1) above; and

(3) diagnostic inspection, which would go beyond the decreed extent of inspection of slaughter animals and meat and serve the aforementioned testing programme.

Such a scheme should be well planned and staffed, and the objectives, approaches, and goals well defined. In addition to very detailed anatomical examination, samples should be tested by histological, serological, parasitological, and microbiological procedures, to determine quality according to the above criteria.

This system, combined with effective inspection aims at:

(1) determining what changes occur in food;

(2) explaining the causes and conditions leading to such changes; and

(3) recommending or imposing measures to prevent these changes when they have adverse effects on quality, or encouraging measures that have a positive influence.

It is important to stress positive influences. This might be new for some veterinarians, since most veterinary activities have previously concentrated on searching for negative influences, such as disease agents, pathological lesions, etc. This will, of course, remain an important objective of veterinary work, but the search for factors that improve food quality must definitely play a more prominent role in future veterinary activities.

Many millions of slaughter animals and tons of meat, milk, eggs, etc. are submitted every year to both veterinary inspection and laboratory testing procedures. The results should be properly recorded and analysed and, most important, should be made available, together with recommendations for their proper use, to the food producers and processers, the appropriate authorities, and the field veterinary services.

THE CHANGING PATTERN OF FOOD HYGIENE PROBLEMS

While it is true that many of the risks that were connected with food adulteration and microbial or parasitic contamination in earlier times have been diminished by the concerted efforts of food hygiene services and producers, several factors have contributed in the past few decades to the need to strengthen food hygiene supervision programmes. These are:

(1) the rapidly increasing world population, with its ever greater demands for food;

(2) the increase in urban populations with a corresponding decrease in rural populations—this change has stimulated increased production of processed or semi-processed foods;

(3) advances in food technology that have been responsible for new and more " sophisticated " presentations of food, the handling of which may not be properly understood by the consumer;

(4) the increased use of agricultural and food chemicals;

(5) the increase in environmental pollution, which, in general, lowers food quality;

(6) increased national and international commerce in food, including the transport of basic materials from areas where hygienic standards may be less than satisfactory; and

(7) increased tourist travel.

Since the Second World War, the techniques of food processing, packaging, and distribution have undergone dramatic changes. The major trend is toward centralized processing and the widespread distribution of commercially prepared convenience foods that minimize or eliminate the need for cooking at the time the meal is prepared. These procedures, which tend to be practised by large undertakings, need to be carefully studied, planned and supervised if health risks for a large proportion of the population are to be avoided.

It is estimated that between two and ten million cases of food-borne illness occur annually in the United States of America, which makes it second only to the common cold as the most frequent ailment afflicting the health of that country. Today 8000–12 000 food items are made available to the consumer by the food industry in the United States of America, whereas at the turn of the century the industry produced and processed less than 100 items.

Food hygienists must give serious attention to problems that arise through modern food production and processing techniques, since these have led to changes in food habits, particularly in developing countries. The inhabitants of such countries have learned to live with the risk of their environment, but new types of food and particularly different ways of preparing food have introduced new risks. In such situations, food hygiene problems are likely to occur, since there may be little food surveillance and control and little knowledge of hygiene.

There is evidence that the potential hazards of food-borne disease are also increasing as a result of increasing numbers of tourists, migrant labour, and other large-scale population movements. For example, it has been estimated that approximately 100 million tourists travel through Europe annually, and that at least 1 %, i.e., 1 000 000, suffer from gastrointestinal troubles.

THE SCOPE OF MODERN FOOD HYGIENE PROGRAMMES

The definition of food hygiene adopted by the FAO/WHO Food Standards Programme, which prepares the Codex Alimentarius, states that: " Food hygiene comprises all measures necessary to ensure the safety, wholesomeness, and soundness of food at all stages from its growth, production, or manufacture until its final consumption ".

In some countries the concept of food hygiene is wider than this; conversely, other countries have still not changed their attitude and the services there remain restricted to some kind of examination and evaluation of food products at the end of their journey from producer to consumer or when they cause food-borne diseases. There are no longer

any scientific, practical, or economic reasons for attempting to solve hygiene problems of food production, processing, and distribution exclusively at this late stage and this old fashioned attitude is not compatible with the modern concepts of preventive medicine.

Food hygienists must adopt an active and progressive policy, they must change the scope of food control from a purely negative measure into a positive force working for improved quality and the prevention of avoidable losses—from the production stage right through to distribution.

The exclusively " policeman " attitude in food hygiene programmes is now outdated. While legislative powers may have to be used in many cases, much better results will be obtained if more emphasis is placed upon preventive hygienic measures. Helpful advice or assistance is readily accepted by the right type of producer and manufacturer.

Elaborate food hygiene control systems already exist in many countries. They enable the hygiene services to cope with many more tasks than just ensuring the safety of the food produced and distributed within the country and imported or exported food. They contribute to the surveillance, prevention, and control of zoonoses and other animal diseases, the reduction of human malnutrition, and the protection of environmental health.

Continuous control system

Experience has shown that the scope of food hygiene programmes should extend from the initial stages of production, for example, the raising and feeding of animals, through all stages of processing, storage, and distribution to the final preparation for serving to the consumer.

This continuous control makes possible the detection of negative factors and conditions at a very early stage when any food of dubious quality has come into contact with only a limited number of people, and few other raw materials, utensils, and premises. Since detection of the majority of negative factors in final food products requires elaborate and expensive procedures and involves much time and effort, early detection of the sources of negative effects and their elimination before they can produce further complications is convenient from both the food hygiene and the economic points of view.

Application of food hygiene programmes

Food hygiene programmes should cover all kinds of food (whether raw, semi-processed, or processed), ingredients, additives, and the water used for preparation, processing, and production. It is also important that the programmes should involve the areas where food is grown or where raw materials are produced, transportation facilities, processing plants and other premises, equipment, utensils, packaging, food handlers, and also the safe disposal of food unfit for human consumption.

To be effective in preventing all negative influences on the hygienic quality of food, the services should deal not only with bacteria, fungi, viruses, or parasites, but also with their toxins, plant and animal biotoxins, chemical substances (either used deliberately in agriculture or the food industry or penetrating the food chain from the living, agricultural, or working environments), radionuclides, etc. A modern classification of food-borne diseases caused by various pathogenic agents is shown in Annex 1.

Food hygiene programmes, if properly planned and organized, contribute substantially to the prevention of those types of food-borne disease that occur among persons handling the food. Direct contact with or inhalation of pathogenic agents, or mechanical injuries,

are common means of contracting these diseases. They may be classified as occupational diseases among people employed in food production, processing, or distribution, although all other food handlers, such as housewives, may also be affected. Examples of food-borne occupational disease are shown in Annex 2.

Methods of surveillance

The annexes clearly show the wide range of pathogenic agents that may adversely affect the health of the food consumer and handler. Moreover, a number of other factors may contribute to deterioration of food in the broad sense of this term and cause losses in quality or quantity. Food hygiene programmes should therefore make use of all categories of laboratory procedure, including organoleptic, physical, chemical, biochemical, microbiological, mycological, virological, parasitological, serological, and radiobiological tests.

These tests do not at all minimize the value of visual on-the-spot inspection of food, premises, processing techniques, etc., which, if properly planned and executed, remain the most important tool of every food hygiene service. Even though laboratories are indispensable to any programme, a system of control based solely on the results of laboratory examination is incomplete. In general terms, the goal of on-the-spot inspection is to find out whether the plant and its operations comply with the codes of hygienic practice laid down by the competent authorities.

During inspection, particular attention should be paid to critical control points. These are the most vulnerable steps at which failure to prevent contamination can be detected with maximum assurance and efficiency by laboratory tests. In theory, if the critical control points have been reliably identified and if the laboratory tests are negative for contamination, the food processer will have maximum confidence that his product is uncontaminated. On the other hand, a positive test result will alert the processer and help locate the source of contamination. Critical control points should be carefully located, therefore, in primary food production, the processing plants, the environment, personnel, and the distribution chain of the finished products.

Further important components of surveillance are the results of: laboratory testing programmes for the food and the environment, morbidity and mortality reporting, medical examination of food handlers, surveillance of zoonoses among domestic and wild animals, surveillance of naturally occuring toxins particularly in fish and shellfish, food and environmental contamination with radionuclides, etc.

The concept of surveillance as a means of assessing food-borne hazards has been steadily increasing in the past few years and, at the present time, there are national and even international networks to monitor microbial pathogens, radionuclides, pesticide residues, marine biotoxins, and a variety of trace elements. Surveillance is certain to become an even more important tool in controlling hazards of food-borne origin in the years to come. To be efficient it needs:

— systematic collection of data
— consolidation and analysis of the data collected
— dissemination of information to all those who provided data and to others.

Registration and licensing of establishments

Preventive activities are becoming more and more important. Modern legislation should incorporate provisions for registration and licensing. The latter is usually required for firms

handling highly perishable food, such as milk, meat, or seafood that may present significant health hazards. Registration may be required for those firms whose normal operations are less likely to involve health hazards. Conditions for registration and licensing vary, but usually the latter include stricter controls and frequent renewals.

The purpose of registration or licensing is the collection of adequate information:

— to assist authorities in planning for inspection and sampling

— to prevent direct health hazards to consumers and food handlers

— to prevent deterioration in the quality of food

— to prevent avoidable losses in the quantity produced

— to contribute to satisfactory working conditions

— to prevent environmental pollution from food production and other food handling procedures.

Registration or licensing is of particular importance before a new or remodelled establishment begins operation. Its value is not, however, restricted to this. Food legislation in some countries requires food producers, processors, and distributors, to apply for registration or licensing of the following, whether home produced or imported:

— buildings

— machines and other equipment

— new techniques in animal husbandry, including standards for animal feed products

— new processing techniques and ingredients

— new standards of food products.

Permits for new or revised techniques are granted only if all legislative requirements are met.

Proposals for registration and licensing must be accompanied by supporting documentation, to facilitate examination and decision. In the case of some new techniques, research is indispensable to elucidate the possible health risks.

Activities aimed at preventing intoxications and chemical residues in foods

Practically all today's raw agricultural products have been treated or exposed to one or more agricultural chemicals or veterinary products in order to increase food production. An additional source of residues in food is environmental pollution by toxic substances either from natural sources or industrial pollution of air, water, soil, feeds, etc. Moreover, a large number of natural and synthetic products coming under the general heading of " food additives " and " feed additives " are incorporated in food for specific purposes.

A tremendous amount of work has been done by veterinarians in dealing with diseases and health risks due to microorganisms, parasites, and other agents of biological origin, and there is no doubt that veterinary services and research and educational institutions have a long and successful tradition in dealing with problems of chemicals associated with animal and food production, processing, transportation, storage, and distribution. However, owing to the increasing quantity and numbers of chemicals used in animal production and related fields, it has become indispensable to broaden and intensify the education and training of veterinarians, as well as to ensure their participation in all sectors of this field.

They are already working continuously in the areas where exposure of animals and food may occur, and they possess adequate knowledge of the routes of entry of such chemicals into food chains, the fate of their residues, and the health hazards involved, as well as of the toxicology, pathology, pathophysiology. Residues present an enormous challenge for surveillance, prevention, and control in agriculture, food processing, and related activities.

WHO is at present elaborating ways of increasing veterinary involvement in this field. Veterinarians should participate in the toxicological and hygienic evaluation of chemicals, and particularly in studies to determine:

(*a*) whether residues impair technological procedures in food processing and the preparation of meals;

(*b*) whether relationships exist between residues and microorganisms present in food that might affect bacterial inhibition, bactericidal or bacteriostatic activities, potentiation of microbial multiplication or toxin production, or the induction of changes in microorganisms such as resistance to antibiotics;

(*c*) whether residues may inhibit the growth of pathogens in food during laboratory examination;

(*d*) whether the quality of food products, and in particular their nutritional value, is adversely affected;

(*e*) whether degradation products or metabolites resulting from cross-reaction with other constituents of the foodstuffs represent health risks.

Such studies are essential for the practical performance of certain veterinary activities.

Veterinarians should also take part in licensing procedures:

(*a*) for chemicals to be used in the agricultural and food industries;

(*b*) for animal production, and the food and feed processing industries;

(*c*) for techniques to be used in the above industries;

(*d*) for importation of chemicals and food products, in order to prevent intoxications and to ensure that residues in foodstuffs do not exceed permitted levels.

Veterinarians should be involved in establishing drug withdrawal times. These should become an indispensable part of the codes on ante- and postmortem inspection and judgement of slaughter animals. Such knowledge allows carcass disposal to be based on the expected excretion pattern. Studies of mode and duration of action, as well as of accelerated elimination of chemical substances from animals, should become an important part of research on every proposed drug.

However, great responsibility rests with the users of chemicals and the agencies supervising their safe use. WHO has elaborated a draft inspection programme aimed at preventing toxic substances and chemical residues in food of animal origin. The competent authorities should ensure, by means of inspection, that the legal requirements relating to protection of health from chemicals and their residues are met at every stage of the food chain from production to consumption.

Legislation and regulations should specify the duties and responsibilities of various sectors of veterinary services. The system of supervision and inspection should enable the responsible officer to check whether all the legal requirements and provisions to protect the food chain from chemical contamination in excess of permitted levels have been met

and to disclose any violations. The legislation should contain provisions for special studies to determine the adequacy of procedures employed throughout the chain of food production, processing, transportation, storage, and distribution and to determine criteria for the safe use of chemicals and for environmental sanitation.

Within the veterinary services, the duties at the production level, including transportation of food animals to abattoirs, should be delegated to field veterinarians. They should be guided by veterinary officers specialized in toxicology and food hygiene.

Ante- and postmortem meat inspection, which should disclose *inter alia* the presence of chemical substances, drugs, biotoxins, or residues on or in meat, is obviously the responsibility of veterinary meat inspectors.

During processing, storage, transportation, and, in many cases, distribution the supervision to prevent residues on or in food above the maximum permitted levels is the responsibility of veterinary food hygienists, within the overall framework of food hygiene supervision.

The need to develop and adopt new laboratory techniques

In spite of the many recent advances in the microbiological analysis of foodstuffs, the search for new methods or modifications and their adoption in routine practice must continue. In particular, more expeditious methods are needed for the determination of chemical metabolites of microorganisms and for the demonstration and determination of microbial toxins, such as staphylococcal enterotoxin and mycotoxins.

Mechanization and automation of some routine laboratory procedures is urgently needed. In microbiological and parasitological examinations, more use should be made of the immunofluorescence technique. Microcalorimetry may also be valuable as an aid to the measurement of microbial activity and it may be possible to apply certain substances to enhance microbial growth and so shorten sensitive detection procedures.

A special problem is the development of quality standards for foodstuffs on the basis of numerical microbial specification. The merit of codifying the upper limit of microbial counts is questioned by some people. Other methods less costly and laborious than microbiological ones may serve the same purpose. This also applies to other specifications. Once a standard has been approved however, it must be observed by all food producers, and checks to ensure this are necessary. Another point worth considering is the requirement that a product be free from pathogenic, potentially pathogenic, and toxicogenic microorganisms. At present, routine laboratory examination within the framework of food hygiene fails to uncover numerous pathogenic microorganisms such as viruses.

Other challenging problems in food hygiene concern potentially pathogenic microflora, psychrophilic, thermophilic, and proteolytic microflora, microbial synergism and antagonism, interrelationships between microorganisms and foreign substances, the development of strains resistant to antibiotics and other antimicrobial drugs, and methods for their detection as well as the use of phase typing.

A most important point concerns the methods of food sampling used for various types of diagnostic examination. Pioneering work based on mathematical–statistical principles has been done by the International Commission on Microbiological Specification for Foods and the FAO/WHO Codex Alimentarius Commission is pursuing these studies.

Little is known of the significance of viruses in food hygiene. At present, a WHO coordinated programme for the detection of viruses in foodstuffs, and the investigation of their epidemiology and persistence under technological treatment is under way.

In Europe, little attention has been paid to the elaboration of methods for the detection of biotoxins in fish meat. This may be due to the fact that in this region food-borne disease of this origin has been rare, whereas in tropical regions, particularly in the Pacific coastal area, its incidence is much higher. The chemical nature of these biotoxins is generally not fully understood, although some progress has recently been made. There is evidence that intoxication with scombrotoxin from scombroid fish, particularly tuna fish, is due not only to histamine arising from muscle tissue histidine by decarboxylation, but also to a substance referred to as saurine and other compounds similar to histamine. Once the nature of fish biotoxins is fully understood, methods can no doubt be developed to detect their presence not only in fish for human consumption, but also in fish meal imported from abroad, which should preferably be termed "concentrates from sea animals", since they are being produced to an ever-increasing extent from unsorted material caught in fishing-nets, the biotoxin content of which is practically unknown.

Education and training

Food hygiene programmes must include adequate training and education of veterinary personnel, food handlers, and consumers.

In a modern food hygiene programme, veterinarians certainly play an important role. Those working in (1) prevention, control, and eradication of diseases, (2) zoohygiene, (3) environmental hygiene, and (4) food hygiene all have a common goal—namely, maximum production of safe foods and maintenance of their good properties until they reach the consumer.

Modern food technology is becoming more and more complicated. Food hygienists must have a good knowledge of production and technology, economics, preservation, and transportation techniques. Modern education and training must take into consideration the rapid developments in food industries and also cover the hygiene and technology of modern products, including for example, ready-to-eat or prepared foods and new ways of food distribution, such as automatic vending machines.

Food hygiene and technology and related subjects are an integral part of education and training in veterinary medicine. In spite of the efforts of other existing or emerging professions, veterinary food hygiene still forms the basis for, and the most important component of, every national food control programme.

RÉSUMÉ

Le rôle des vétérinaires dans l'hygiène alimentaire moderne

L'évolution des techniques de production des aliments d'origine animale — et en particulier la substitution de l'élevage intensif dans de grandes exploitations aux méthodes traditionnelles — est appelée à se poursuivre si l'on veut développer efficacement cette production. Mais le développement de la nouvelle technologie doit être soigneusement planifié et contrôlé afin d'éviter toute détérioration de la qualité des aliments et tout accroissement de la pollution du milieu qui pourraient nuire à la santé humaine. Les vétérinaires ont un rôle important à jouer dans ce domaine et ils devraient être associés à chacune des étapes de la production — de la planification du développement aux techniques de transformation. Il leur appartient notamment de contrôler l'application de normes

strictes aussi bien à la nourriture des animaux d'élevage qu'aux produits d'origine animale destinés à la consommation humaine. Il convient d'ailleurs d'assurer, sur le plan de la santé publique, une étroite coopération entre les vétérinaires chargés de l'inspection des viandes dans les abattoirs et les vétérinaires de terrain qui sont mieux renseignés sur la situation épidémiologique et sur les médicaments qui ont pu être administrés aux animaux.

Les nouveaux problèmes. Les raisons qui nécessitent un renforcement du contrôle de l'hygiène alimentaire — en dépit des progrès réalisés dans la lutte contre la contamination microbienne ou parasitaire et la falsification — tiennent à l'augmentation de la population (principalement urbaine) et des transports internationaux des personnes et des biens de consommation, ainsi qu'à l'usage croissant de produits chimiques en agriculture et aux diverses étapes de la chaîne alimentaire. La préparation et le conditionnement des produits ont eux aussi beaucoup changé et sont de plus en plus centralisés. Dans les pays en développement, l'ignorance des règles d'hygiène peut rendre également dangereux les produits de base exportés et les produits conditionnés importés et mal utilisés. Il en résulte, à l'échelle mondiale, une forte augmentation des infections d'origine alimentaire, notamment des troubles gastro-intestinaux.

Les divers aspects d'un programme d'hygiène alimentaire moderne. Il arrive encore dans certains pays que seul le produit final, à l'extrémité de la chaîne, soit examiné — et parfois seulement lorsqu'il est présumé responsable d'intoxication. Or ceci n'est pas compatible avec le principe de la prévention, lequel implique un contrôle s'étendant à tout le cycle de production et de distribution. L'intervention aux stades initiaux présente d'ailleurs des avantages économiques évidents, car elle fait appel à des méthodes relativement simples, et elle limite le risque d'une contamination étendue. La surveillance doit s'appliquer à tout produit destiné à la consommation alimentaire — brut, semi-préparé ou transformé — ainsi qu'aux ingrédients, à l'eau et aux additifs utilisés et aux procédés de fabrication. La région de production doit être aussi surveillée, de même que les moyens de transport, les usines et entrepôts, le matériel, les emballages et les manipulateurs. En cas de nécessité, l'élimination des produits jugés dangereux doit se faire dans les conditions de sécurité requises. Outre les microbes et parasites classiques — et leurs toxines — il faut surveiller les biotoxines végétales et animales, les substances chimiques utilisées volontairement ou introduites dans la chaîne alimentaire à partir de l'environnement, les radionucléides, etc. L'annexe 1 présente une classification des maladies causées par divers agents présents dans les aliments. La production, la transformation ou la manipulation des produits alimentaires peuvent provoquer des maladies chez les travailleurs y participant (ou chez les ménagères); ces « maladies professionnelles » figurent à l'annexe 2.

A côté des nombreux tests de laboratoire à effectuer, l'inspection visuelle sur les lieux de production garde toute sa valeur. Il convient de déterminer les « points critiques » et de les soumettre aux opérations de contrôle nécessaires en laboratoire. Les réseaux internationaux chargés de la surveillance des agents pathogènes, résidus de pesticides, biotoxines marines et divers oligoéléments ou radionucléides doivent recueillir toute information pertinente, l'analyser et la diffuser. Dans l'action préventive, la législation intervient pour réglementer l'enregistrement et l'homologation, notamment celle des établissements traitant des denrées hautement périssables et potentiellement dangereuses, telles que le lait, la viande et les fruits de mer. Cette formalité, qui permet aux autorités compétentes d'obtenir tout renseignement utile pour le contrôle ultérieur, peut porter aussi bien sur les locaux et le matériel que sur toute technique nouvelle utilisée (pour l'élevage et la transformation) ou toute nouvelle norme mise en application.

On peut considérer qu'il n'est guère aujourd'hui de produit agricole brut qui n'ait été traité par, ou exposé à, quelque produit chimique ou vétérinaire, auquel s'ajoutent les résidus des industries polluant le milieu et les additifs alimentaires. Les vétérinaires ont certes une grande expérience des agents biologiques contaminants, mais la multiplication des substances chimiques dangereuses exige un élargissement permanent de leur champ d'action. L'OMS étudie les moyens de les faire participer au maximum à l'évaluation toxicologique et hygiénique de ces substances, et en particulier aux études sur l'action des résidus et les interactions éventuelles entre ceux-ci et d'autres constituants alimentaires ou micro-organismes présents dans les aliments. Les vétérinaires devraient aussi intervenir dans le processus d'homologation ou autorisation concernant tout produit chimique utilisé en agriculture ou dans l'industrie alimentaire, toute entreprise d'élevage et de fabrication d'aliments pour animaux (et les techniques qu'elle envisage d'appliquer), enfin toute importation de produit chimique ou alimentaire. Leur concours s'impose également pour déterminer le temps nécessaire à l'élimination des médicaments administrés aux animaux d'élevage — aspect important de la recherche sur tout nouveau médicament proposé. Leur intervention ne diminue toutefois en rien la responsabilité des usagers de ces produits chimiques, dont l'emploi fait l'objet d'une proposition de programme d'inspection élaboré par l'OMS. Dans leurs activités de surveillance, les vétérinaires doivent pouvoir s'appuyer sur une réglementation bien établie; ceux qui opèrent sur le terrain travailleront en liaison avec leurs collègues spécialisés en toxicologie et en hygiène des produits alimentaires. La législation doit aussi prévoir toute étude requise pour vérifier que les techniques appliquées d'un bout à l'autre de la chaîne sont adéquates.

En dépit des progrès intervenus, l'analyse microbiologique des aliments et son exécution de routine appellent un supplément d'étude. L'identification des métabolites chimiques des micro-organismes et celle des toxines microbiennes doivent être encore améliorées. L'automatisation des techniques de laboratoire devrait être plus poussée et le recours à la technique d'immunofluorescence plus répandu. Les examens de laboratoire ne permettant pas encore de déceler tous les micro-organismes pathogènes — en particulier les virus — l'OMS coordonne un programme d'enquêtes relatives à leur épidémiologie. Enfin, la recherche de biotoxines dans les poissons n'est pas encore systématique en Europe (où elles sont plus rares que dans les régions tropicales), mais l'importation de farine de poisson préparée à partir d'un mélange indéterminé d'animaux marins devrait inciter à accroître les efforts dans ce domaine. Pour tous ces examens, on doit disposer de méthodes d'échantillonnage adéquates et celles-ci font l'objet, dans le cadre du programme commun FAO/OMS sur les normes alimentaires, d'études dont les bases ont été posées par la Commission internationale pour la définition des caractéristiques microbiologiques des aliments.

La formation que reçoivent les vétérinaires — dont le concours est capital pour l'exécution de tout programme national de surveillance des denrées alimentaires — doit leur permettre de faire face à la diversité des nouvelles techniques employées dans le secteur alimentaire et aux changements rapides qui caractérisent celui-ci.

Annex 1

CLASSIFICATION OF FOOD-BORNE INFECTIONS AND INTOXICATIONS

1. Bacterial
   a) Bacterial infections (e.g., salmonellosis, typhoid fever, paratyphoid fever, *Vibrio parahaemolyticus* infections, and shigellosis);

b) Bacterial intoxications (e.g., botulism, and staphylococcal food poisoning);

c) Bacterial intravital intoxication [a] (e.g., cholera, *Clostridium perfringens* food poisoning).

2. Fungal
   a) Mycotic infections (e.g., phycomycosis (mucormycosis, zygomycosis)).
   b) Mycotoxicosis (e.g., aflatoxicosis, alimentary toxic aleukia, ergotism).
3. Parasitic (e.g., clonorchiasis, paragonimiasis, diphyllobothriasis, anisakiasis).
4. Viral (e.g., infectious hepatitis).
5. Intoxications due to chemical poisons (e.g., chronic mercury poisoning—Minamata disease).
6. Intoxications due to biotoxins (e.g., paralytic shellfish poisoning, tetraodon poisoning, ciguatera poisoning).
7. Allergic reactions following ingestion.
8. Undetermined etiology (e.g., agents causing summer diarrhoea).

Annex 2

OCCUPATIONAL DISEASES ASSOCIATED WITH FOOD

1. Zoonoses (e.g., tuberculosis, brucellosis, anthrax) contracted by direct contact with, for example, diseased slaughter-animals or products thereof, e.g., anthrax through handling contamined skins, hides, or wool.

   Many diseases transmissible from animals to man are recognized as occupational hazards. These are of concern to government agencies responsible for health and for occupational safety. For example, hunters or others handling rabbits may be exposed to tularaemia. Livestock breeders, abattoir workers, and those handling hides or hair from infected animals run the hazards of anthrax. Psittacosis has been transmitted to workers in poultry slaughterhouses. The participation of food hygiene officials may be helpful in epidemiological investigations and in programmes to improve hygienic measures to protect workers as well as consumers.
2. Incidental diseases acquired through environmental conditions associated with food handling (e.g., leptospirosis, schistosomiasis).
3. Secondary bacterial skin infections facilitated by mechanical injuries (e.g., streptococcal and staphylococcal infections, and erysipeloid).
4. Bites and stings (e.g., the bite of the moray eel, the sting of some catfishes, and the sting of some molluscan gastropods).
5. Allergic reaction due to contact with fish, shellfish, or fishing gear bearing marine organisms.

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[a] Intoxication by toxin produced in the body by bacteria present in heavily contaminated foods.